International IƆR Rectifier

## IRF3007SPbF
IRF3007LPbF

Typical Applications
- Industrial Motor Drive

Features
- Ultra Low On-Resistance
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to Tjmax
- Lead-Free

HEXFET® Power MOSFET

V_{DSS} = 75V

$R_{DS(on)}$ = 0.0126Ω

I_D = 62A

Description

This design of HEXFET® Power MOSFETs utilizes the lastest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this HEXFET power MOSFET are a 175°C junction operating temperature, fast switching speed and improved repetitive avalanche rating. These combine to make this design an extremely efficient and reliable device for use in a wide variety of applications.

D²Pak
IRF3007SPbF

TO-262
IRF3007LPbF
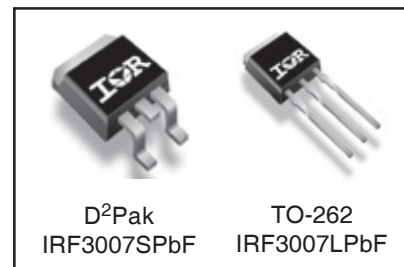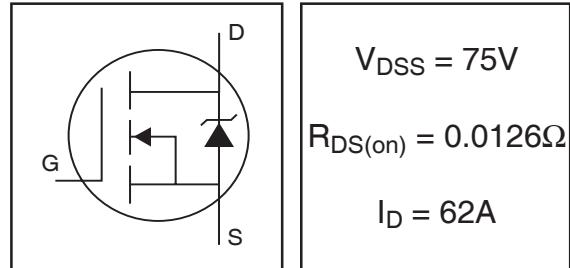
Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V	62	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V	44	
I_{DM}	Pulsed Drain Current ①	320	
P_D @T_C = 25°C	Power Dissipation	120	W
	Linear Derating Factor	0.8	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy②	290	mJ
E_{AS} (6 sigma)	Single Pulse Avalanche Energy Tested Value⑦	946	
I_{AR}	Avalanche Current①	See Fig.12a, 12b, 15, 16	A
E_{AR}	Repetitive Avalanche Energy⑥		mJ
T_J	Operating Junction and	-55 to + 175	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	

Thermal Resistance

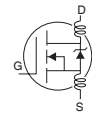|	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	——	1.25	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB Mounted,steady state)**	——	62	

** This is applied to D²Pak, when mounted on 1" square PCB (FR-4 or G-10 Material).
   For recommended footprint and soldering techniques refer to application note #AN-994.

07/23/10

Electrical Characteristics @ $T_J = 25°C$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	75	——	——	V	$V_{GS} = 0V$, $I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	——	0.084	——	V/°C	Reference to 25°C, $I_D = 1mA$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	——	10.5	12.6	$m\Omega$	$V_{GS} = 10V$, $I_D = 48A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0	——	4.0	V	$V_{DS} = 10V$, $I_D = 250\mu A$
g_{fs}	Forward Transconductance	180	——	——	S	$V_{DS} = 25V$, $I_D = 48A$
I_{DSS}	Drain-to-Source Leakage Current	——	——	20	μA	$V_{DS} = 75V$, $V_{GS} = 0V$
		——	——	250		$V_{DS} = 60V$, $V_{GS} = 0V$, $T_J = 150°C$
I_{GSS}	Gate-to-Source Forward Leakage	——	——	200	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	——	——	-200		$V_{GS} = -20V$
Q_g	Total Gate Charge	——	89	130		$I_D = 48A$
Q_{gs}	Gate-to-Source Charge	——	21	32	nC	$V_{DS} = 60V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	——	30	45		$V_{GS} = 10V$
$t_{d(on)}$	Turn-On Delay Time	——	12	——		$V_{DD} = 38V$
t_r	Rise Time	——	80	——	ns	$I_D = 48A$
$t_{d(off)}$	Turn-Off Delay Time	——	55	——		$R_G = 4.6\Omega$
t_f	Fall Time	——	49	——		$V_{GS} = 10V$ ④
L_D	Internal Drain Inductance	——	4.5	——	nH	Between lead, 6mm (0.25in.) from package and center of die contact
L_S	Internal Source Inductance	——	7.5	——		
C_{iss}	Input Capacitance	——	3270	——		$V_{GS} = 0V$
C_{oss}	Output Capacitance	——	520	——	pF	$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	——	78	——		$f = 1.0MHz$, See Fig. 5
C_{oss}	Output Capacitance	——	3500	——		$V_{GS} = 0V$, $V_{DS} = 1.0V$, $f = 1.0MHz$
C_{oss}	Output Capacitance	——	340	——		$V_{GS} = 0V$, $V_{DS} = 60V$, $f = 1.0MHz$
C_{oss} eff.	Effective Output Capacitance ⑤	——	640	——		$V_{GS} = 0V$, $V_{DS} = 0V$ to 60V

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	——	——	80⑥	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	——	——	320		
V_{SD}	Diode Forward Voltage	——	——	1.3	V	$T_J = 25°C$, $I_S = 48A$, $V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	——	85	130	ns	$T_J = 25°C$, $I_F = 48A$, $V_{DD} = 38V$
Q_{rr}	Reverse Recovery Charge	——	280	420	nC	$di/dt = 100A/\mu s$ ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$)				

Notes:

① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).

② Starting $T_J = 25°C$, $L = 0.24mH$ $R_G = 25\Omega$, $I_{AS} = 48A$, $V_{GS} = 10V$ (See Figure 12).

③ $I_{SD} \le 48A$, $di/dt \le 330A/\mu s$, $V_{DD} \le V_{(BR)DSS}$, $T_J \le 175°C$

④ Pulse width $\le 400\mu s$; duty cycle $\le 2\%$.

⑤ C_{oss} eff. is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

⑥ Limited by T_{Jmax} , see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.

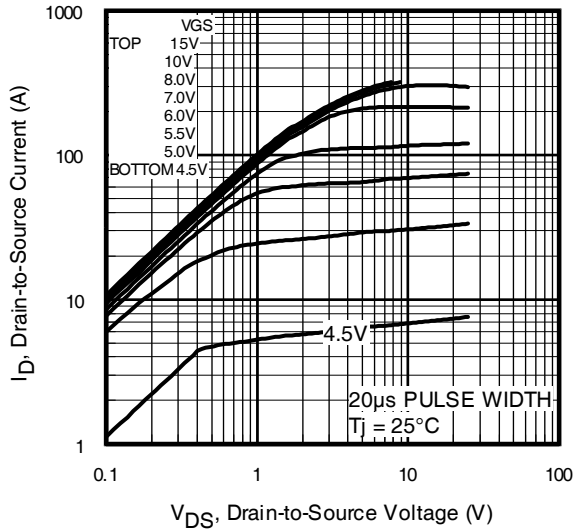⑦ This value determined from sample failure population. 100% tested to this value in production.

International IOR Rectifier
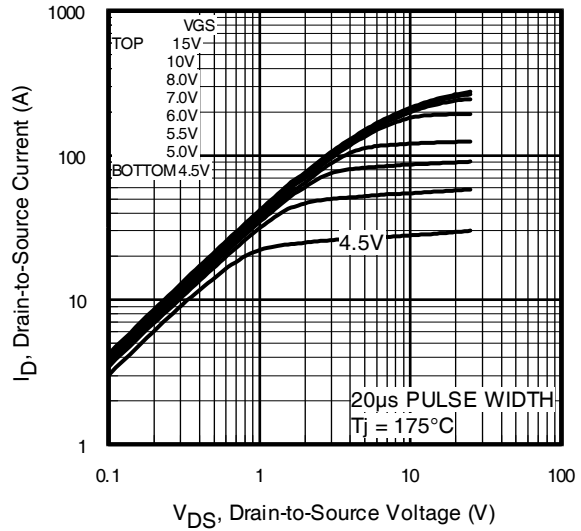
Fig 1. Typical Output Characteristics

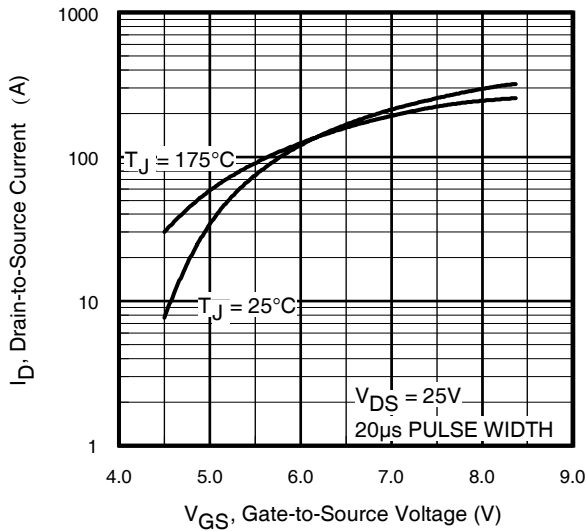**Fig 2.** Typical Output Characteristics

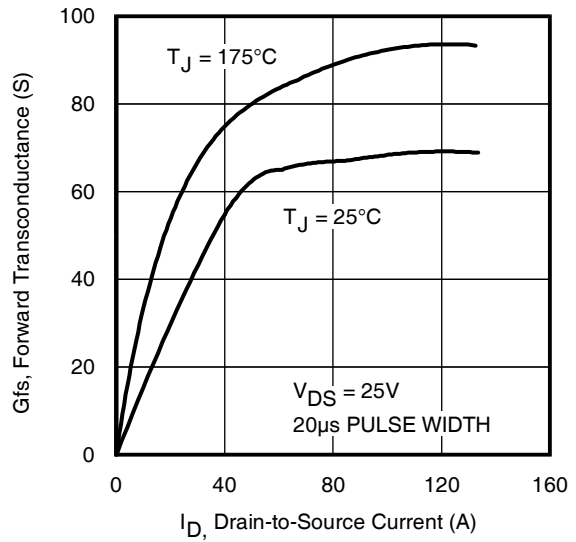**Fig 3.** Typical Transfer Characteristics

Fig 4. Typical Forward Transconductance Vs. Drain Current
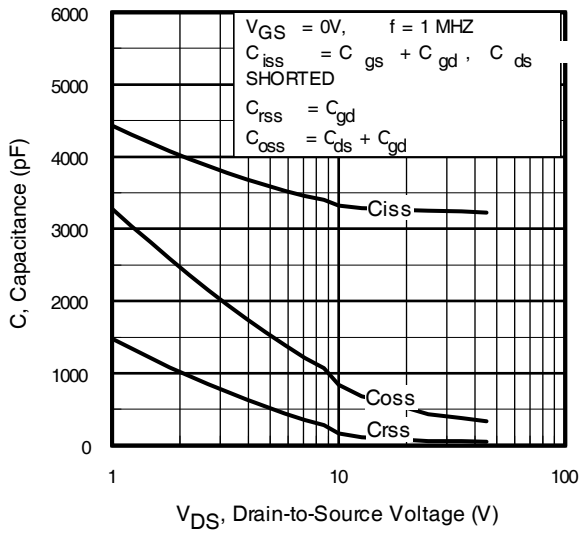
IRF3007S/LPbF

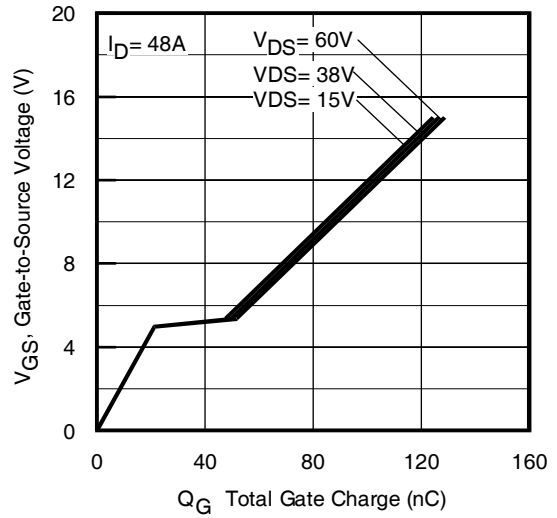**Fig 5.** Typical Capacitance Vs.
Drain-to-Source Voltage
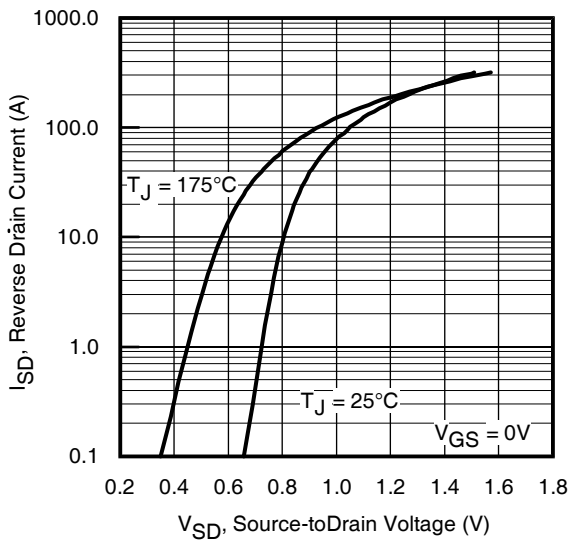
Fig 6. Typical Gate Charge Vs.
Gate-to-Source Voltage
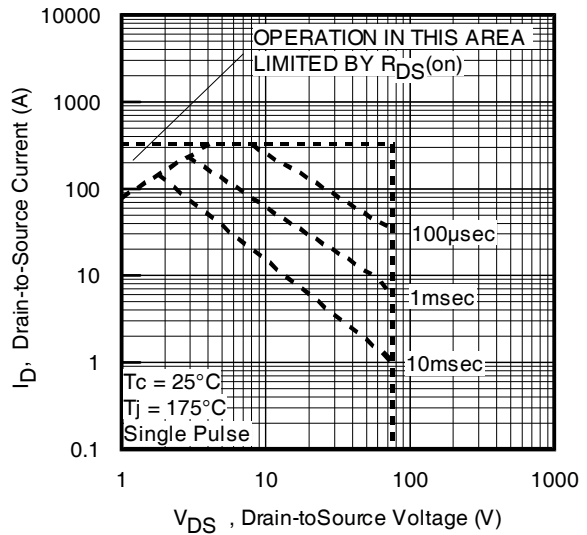
Fig 7. Typical Source-Drain Diode
Forward Voltage

Fig 8. Maximum Safe Operating Area

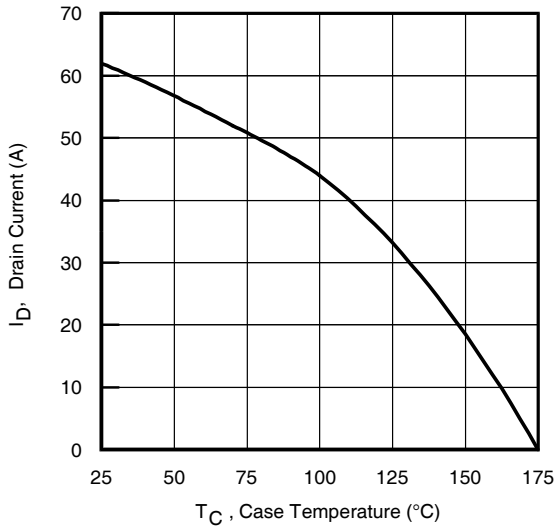IRF3007S/LPbF

Fig 9. Maximum Drain Current Vs. Case Temperature
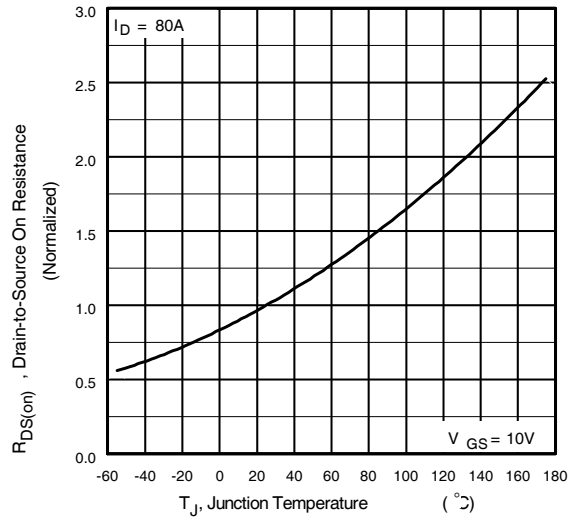

Fig 10. Normalized On-Resistance Vs. Temperature
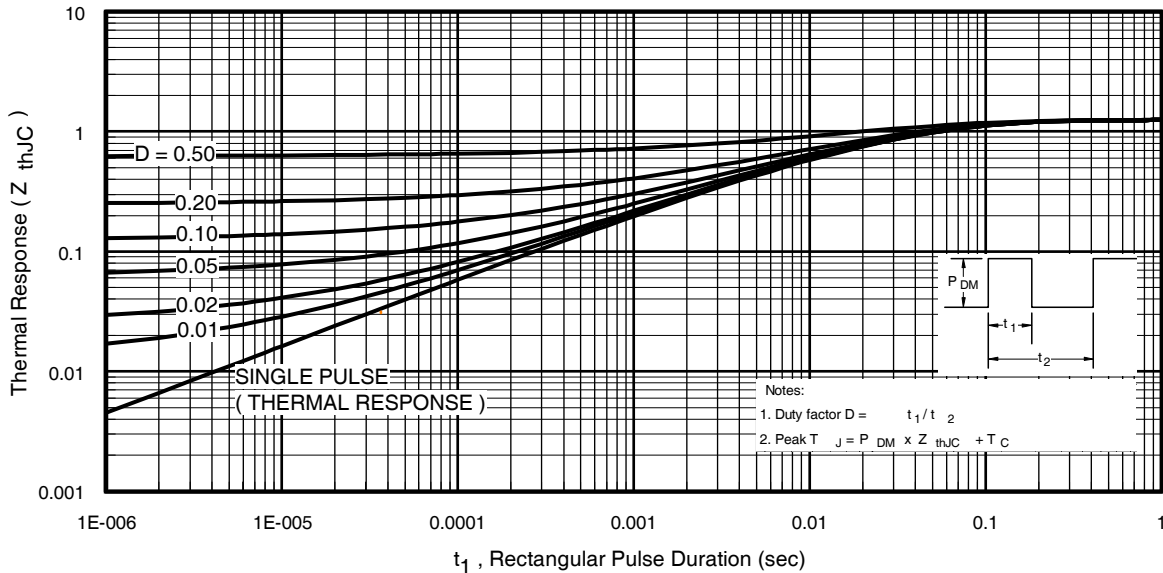

Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case
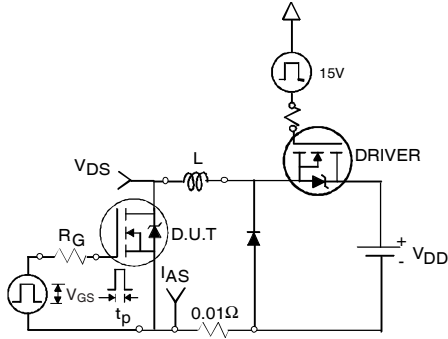
IRF3007S/LPbF

Fig 12a. Unclamped Inductive Test Circuit
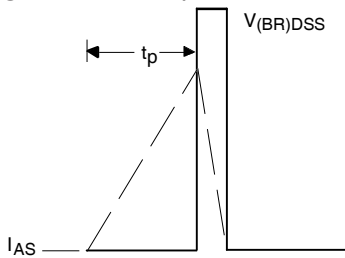

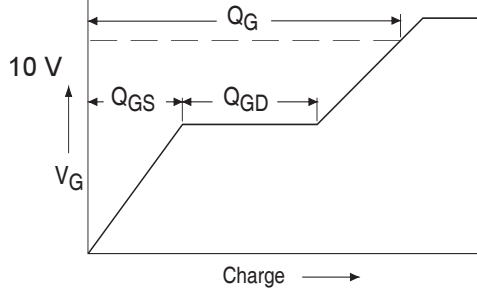**Fig 12b.** Unclamped Inductive Waveforms

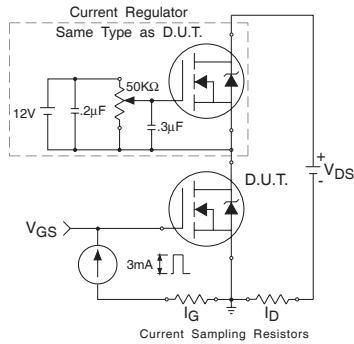**Fig 13a.** Basic Gate Charge Waveform

Fig 13b. Gate Charge Test Circuit
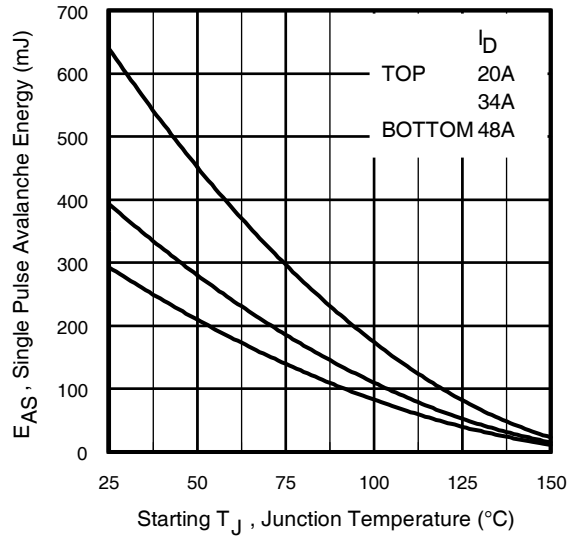

Fig 12c. Maximum Avalanche Energy
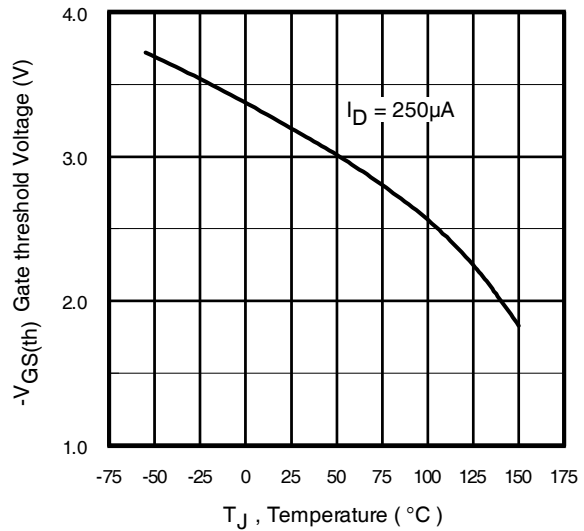Vs. Drain Current

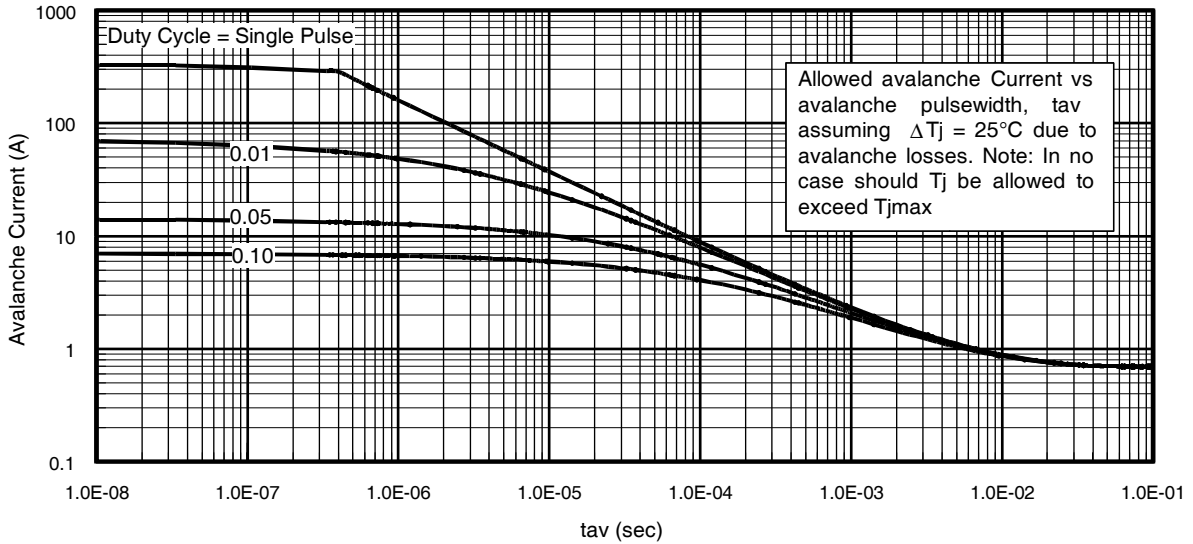**Fig 14.** Threshold Voltage Vs. Temperature

6

Fig 15. Typical Avalanche Current Vs.Pulsewidth
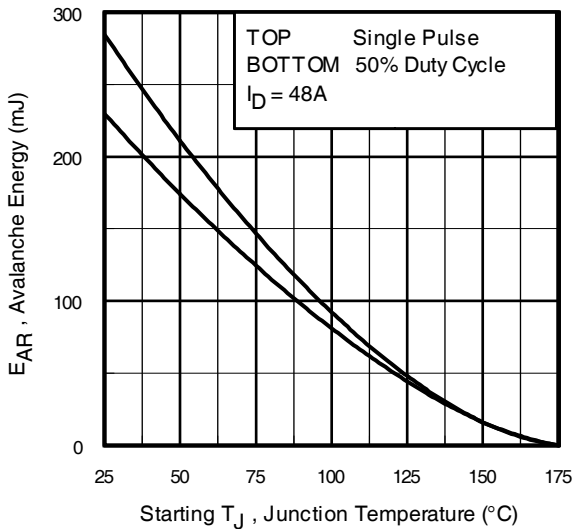
Fig 16. Maximum Avalanche Energy Vs. Temperature

Notes on Repetitive Avalanche Curves , Figures 15, 16: (For further info, see AN-1005 at www.irf.com)

1. Avalanche failures assumption:
   Purely a thermal phenomenon and failure occurs at a temperature far in excess of T_{jmax}. This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as T_{jmax} is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 12a, 12b.
4. $P_{D\,(ave)}$ = Average power dissipation per single avalanche pulse.
5. BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
6. I_{av} = Allowable avalanche current.
7. ΔT = Allowable rise in junction temperature, not to exceed T_{jmax} (assumed as 25°C in Figure 15, 16).
   t_{av} = Average time in avalanche.
   D = Duty cycle in avalanche = $t_{av} \cdot f$
   $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see figure 11)

$$P_{D\,(ave)} = 1/2\,(\,1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$
$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$
$$E_{AS\,(AR)} = P_{D\,(ave)} \cdot t_{av}$$

D.U.T

Circuit Layout Considerations
• Low Stray Inductance
• Ground Plane
• Low Leakage Inductance
  Current Transformer

• dv/dt controlled by R_G
• Driver same type as D.U.T.
• I_{SD} controlled by Duty Factor "D"
• D.U.T. - Device Under Test

R_G

V_{DD}

① Driver Gate Drive

P.W. — Period — $D = \dfrac{P.W.}{Period}$

V_{GS}=10V *

② D.U.T. I_{SD} Waveform

Reverse
Recovery
Current

Body Diode Forward
Current
di/dt

③ D.U.T. V_{DS} Waveform

Diode Recovery
dv/dt

V_{DD}

Re-Applied
Voltage

Body Diode Forward Drop

④ Inductor Curent

Ripple ≤ 5%

I_{SD}

* V_{GS} = 5V for Logic Level Devices

Fig 17. Peak Diode Recovery dv/dt Test Circuit for N-Channel
HEXFET® Power MOSFETs

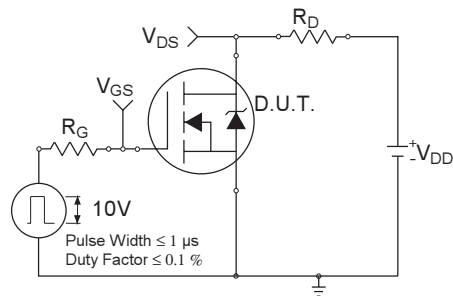V_{DS} R_D

V_{GS}

R_G D.U.T.

$^+_-V_{DD}$

10V

Pulse Width ≤ 1 μs
Duty Factor ≤ 0.1 %

Fig 18a. Switching Time Test Circuit

V_{DS}

90%

10%

V_{GS}

$t_{d(on)}$ t_r $t_{d(off)}$ t_f
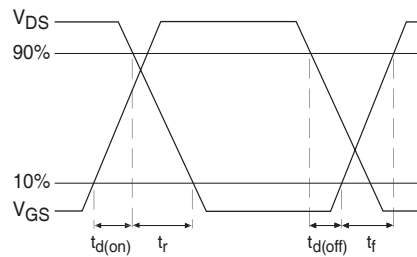
Fig 18b. Switching Time Waveforms

D²Pak (TO-263AB) Package Outline

Dimensions are shown in millimeters (inches)
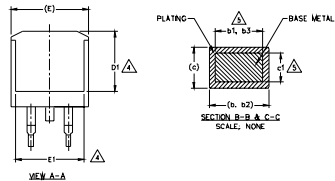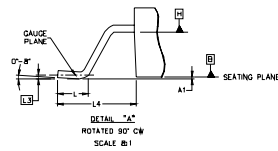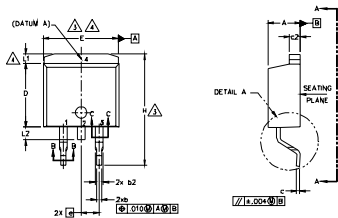
S Y M B O L	DIMENSIONS				N O T E S
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	0.00	0.254	.000	.010	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	5
c2	1.14	1.65	.045	.065	
D	8.38	9.65	.330	.380	3
D1	6.86	–	.270		4
E	9.65	10.67	.380	.420	3,4
E1	6.22	–	.245		4
e	2.54 BSC		.100 BSC		
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1	–	1.65	–	.066	4
L2	–	1.78	–	.070	
L3	0.25 BSC		.010 BSC		
L4	4.78	5.28	.188	.208	

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
6. DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
7. CONTROLLING DIMENSION: INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-263AB.

D²Pak (TO-263AB) Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH LOT CODE 8024 ASSEMBLED ON WW 02, 2000 IN THE ASSEMBLY LINE "L"

Note: "P" in assembly line position indicates "Lead – Free"

INTERNATIONAL RECTIFIER LOGO

PART NUMBER

ASSEMBLY LOT CODE

DATE CODE
YEAR 0 = 2000
WEEK 02
LINE L

OR

INTERNATIONAL RECTIFIER LOGO

PART NUMBER

ASSEMBLY LOT CODE

DATE CODE
P = DESIGNATES LEAD - FREE PRODUCT (OPTIONAL)
YEAR 0 = 2000
WEEK 02
A = ASSEMBLY SITE CODE

Notes:
1. For an Automotive Qualified version of this part please see http://www.irf.com/product-info/auto/
2. For the most current drawing please refer to IR website at http://www.irf.com/package/

IRF3007S/LPbF

TO-262 Package Outline
Dimensions are shown in millimeters (inches)
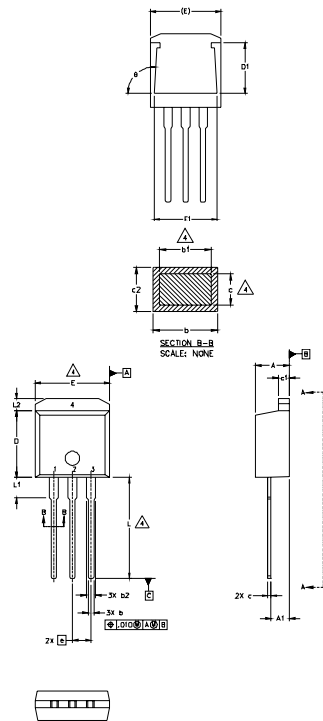
S Y M B O L	DIMENSIONS				N O T E S
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	2.03	2.92	.080	.115	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	4
b2	1.14	1.40	.045	.055	
c	0.38	0.63	.015	.025	4
c1	1.14	1.40	.045	.055	
c2	0.43	.063	.017	.029	
D	8.51	9.65	.335	.380	3
D1	5.33		.210		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54 BSC		.100 BSC		
L	13.46	14.09	.530	.555	
L1	3.56	3.71	.140	.146	
L2		1.65		.065	

LEAD ASSIGNMENTS

HEXFET
1.– GATE
2.– DRAIN
3.– SOURCE
4.– DRAIN

IGBT
1 – GATE
2 – COLLECTOR
3 – EMITTER

NOTES:
DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

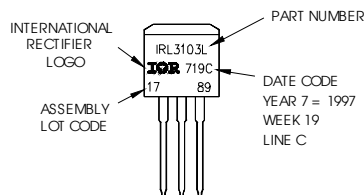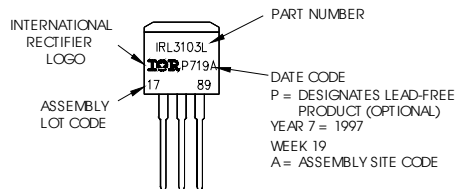## TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

Note: "P" in assembly line
position indicates "Lead-Free"

INTERNATIONAL RECTIFIER LOGO

PART NUMBER

ASSEMBLY LOT CODE

DATE CODE
YEAR 7 = 1997
WEEK 19
LINE C

IRL3103L
I⚙R 719C
17   89

OR

INTERNATIONAL RECTIFIER LOGO

PART NUMBER

ASSEMBLY LOT CODE

DATE CODE
P = DESIGNATES LEAD-FREE
PRODUCT (OPTIONAL)
YEAR 7 = 1997
WEEK 19
A = ASSEMBLY SITE CODE

IRL3103L
I⚙R P719A
17   89

Notes:
1. **For an Automotive Qualified version of this part please see** http://www.irf.com/product-info/auto/
2. **For the most current drawing please refer to IR website at** http://www.irf.com/package/

www.irf.com

IRF3007S/LPbF

D²Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)

TRR

FEED DIRECTION

TRL

FEED DIRECTION

1.60 (.063)
1.50 (.059)

4.10 (.161)
3.90 (.153)

ø 1.60 (.063)
1.50 (.059)

1.85 (.073)
1.65 (.065)

11.60 (.457)
11.40 (.449)

0.368 (.0145)
0.342 (.0135)

24.30 (.957)
23.90 (.941)

15.42 (.609)
15.22 (.601)

10.90 (.429)
10.70 (.421)

ø 1.75 (.069)
1.25 (.049)

4.72 (.136)
4.52 (.178)

16.10 (.634)
15.90 (.626)

13.50 (.532)
ø 12.80 (.504)

ø 330.00
(14.173)
MAX.

27.40 (1.079)
23.90 (.941)

④

ø 60.00 (2.362)
MIN.

30.40 (1.197)
MAX.

④

26.40 (1.039)
24.40 (.961)

③
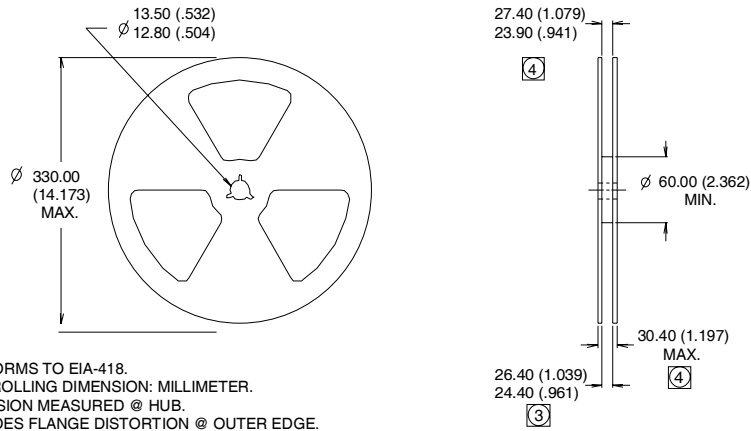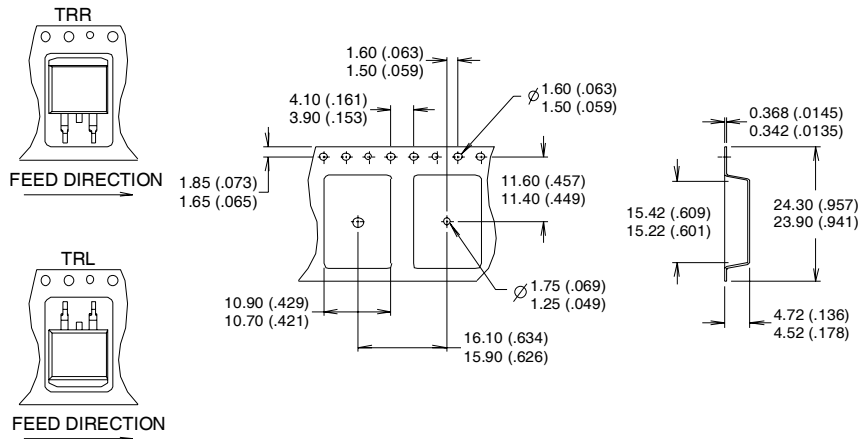
NOTES :
1. COMFORMS TO EIA-418.
2. CONTROLLING DIMENSION: MILLIMETER.
③ DIMENSION MEASURED @ HUB.
④ INCLUDES FLANGE DISTORTION @ OUTER EDGE.

Data and specifications subject to change without notice.
This product has been designed and qualified for the Industrial market.
Qualification Standards can be found on IR's Web site.

International **IꟼR** Rectifier

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